

*This is for dignity that the finest and
blondest leaders of the Grand Magistrate Empire*

King Floorsh 727

and his most majestic lions

Prince Floorsh 418

*are especially invited by their
most humble scientist and scientist*

Bloort 183

*to an exclusive tour of the newly
constructed, state-of-the-art*

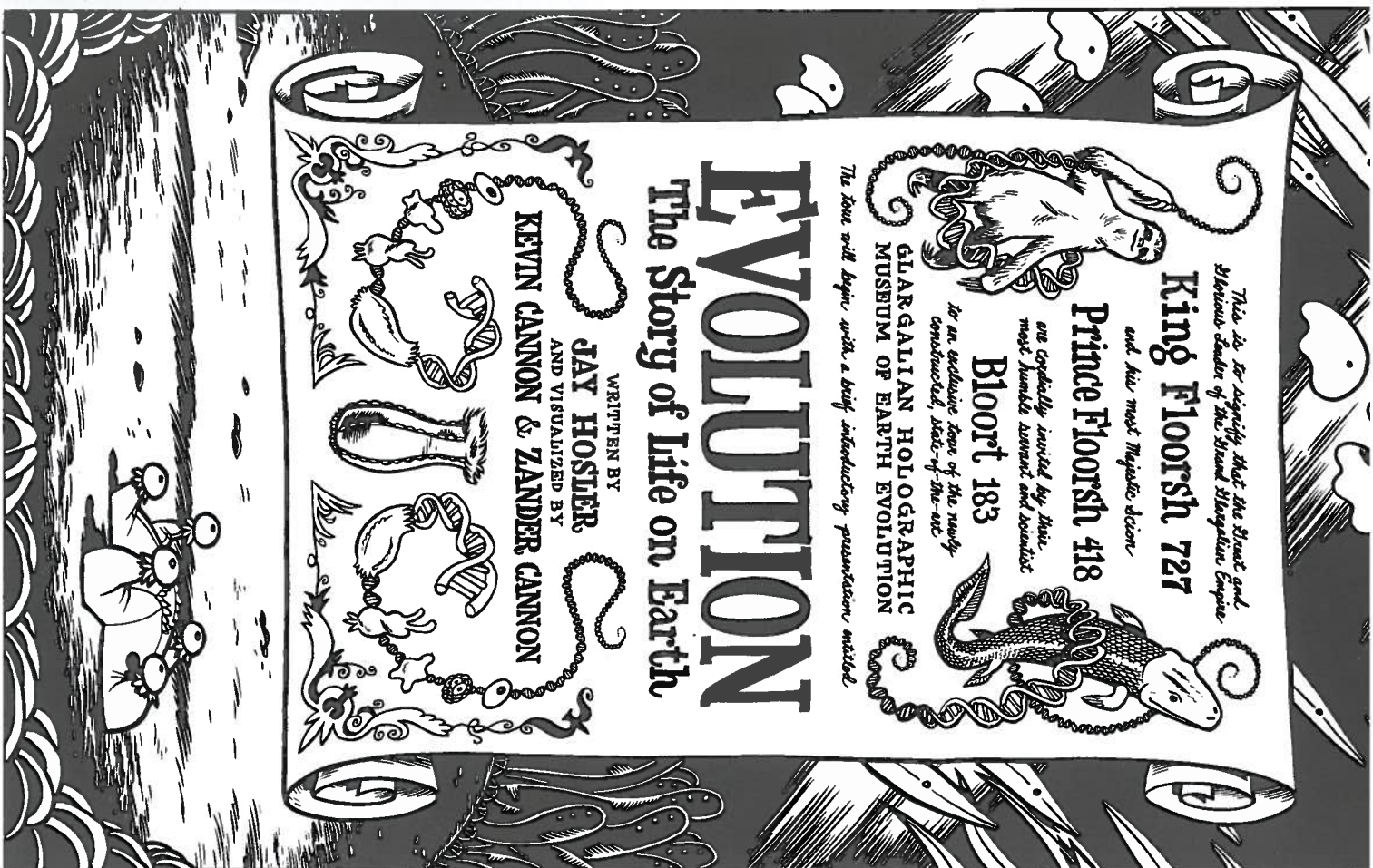
**GLARGALIAN HOLOGRAPHIC
MUSEUM OF EARTH EVOLUTION**

The tour will begin with a brief introductory presentation, entitled

EVOLUTION

The Story of Life on Earth

WRITTEN BY
JAY HOSTLER
AND VISUALIZED BY
KEVIN CANNON & ZANDER CANNON



**GREAT
GLARGALLY-
MARGALLY!!**



THE FIRST LIFE DISCOVERED BEYOND GLARGAL.

A CLOSER INSPECTION REVEALED AN EXUBERANT VARIETY OF LIVING THINGS. WHERE DID THEY ALL COME FROM? WHAT WAS THE SOURCE OF THIS INCREDIBLE DIVERSITY?



GOOD THING
I BROUGHT AN
UMBRELLA.

BECAUSE OF THIS, ORGANISMS ON EARTH ARE FORCED TO EVOLVE INNOVATIVE SOLUTIONS TO VARIOUS THREATS TO THEIR EXISTENCE. CHALLENGES TO SURVIVAL CAN COME FROM ANYWHERE, EVEN OUTER SPACE.



THE ANSWER, IN PART, IS THAT LIFE ON EARTH IS TOUGH. THERE ISN'T ENOUGH WATER, FOOD, AND SPACE FOR EVERY ORGANISM, SO THERE IS A STRUGGLE TO SURVIVE.



DURING ITS LONG HISTORY, EARTH HAS UNDERGONE DRAMATIC CHANGES. THE VERY CONTINENTS HAVE SHIFTED, ISLANDS AND OCEANS HAVE COME AND GONE. THE PLANET HAS PERIODICALLY FROZEN AND THAWED.



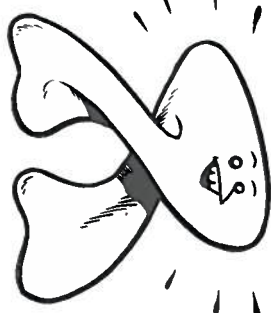
HOI AFTER IT FORMED THAT ALL THE ROCKS WERE LIQUEFIED. IT REMAINED THIS WAY FOR ABOUT 500 MILLION YEARS, UNTIL THINGS COOLED DOWN AND A HARD OUTER LAYER, CALLED A CRUST, FORMED.



AT ABOUT THE SAME TIME, A THIN LAYER OF GASSES WERE TRAPPED BY EARTH'S GRAVITY. THIS FORMED THE PLANET'S ORIGINAL ATMOSPHERE, A NOXIOUS MIX OF METHANE, AMMONIA, AND HYDROGEN.

MOLECULES MIXED AND REACTED, FORMING COMPLEX CHAINS. SOME OF THESE COULD MAKE COPIES OF THEMSELVES. THEY WERE THE FORERUNNERS OF GENETIC MOLECULES LIKE RNA AND DNA...

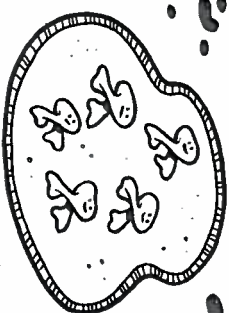
...THE VERY STUFF OF LIFE!



RIBOZYME

MAKING COPIES OF YOURSELF IN A BIG, BLUBBING STEW CAN BE A CHALLENGE. SOME OF THESE EARLY SELF-COPYING MOLECULES FOUND REFUGE INSIDE OF WATERY BAGS WITH THIN, FATTY MEMBRANES.

THESE EARLY CELLS PROVIDED A STABLE ENVIRONMENT FOR THE GENETIC MATERIAL AND GAVE THEM A BIG ADVANTAGE OVER THOSE MOLECULES THAT REMAINED EXPOSED TO THE ELEMENTS.

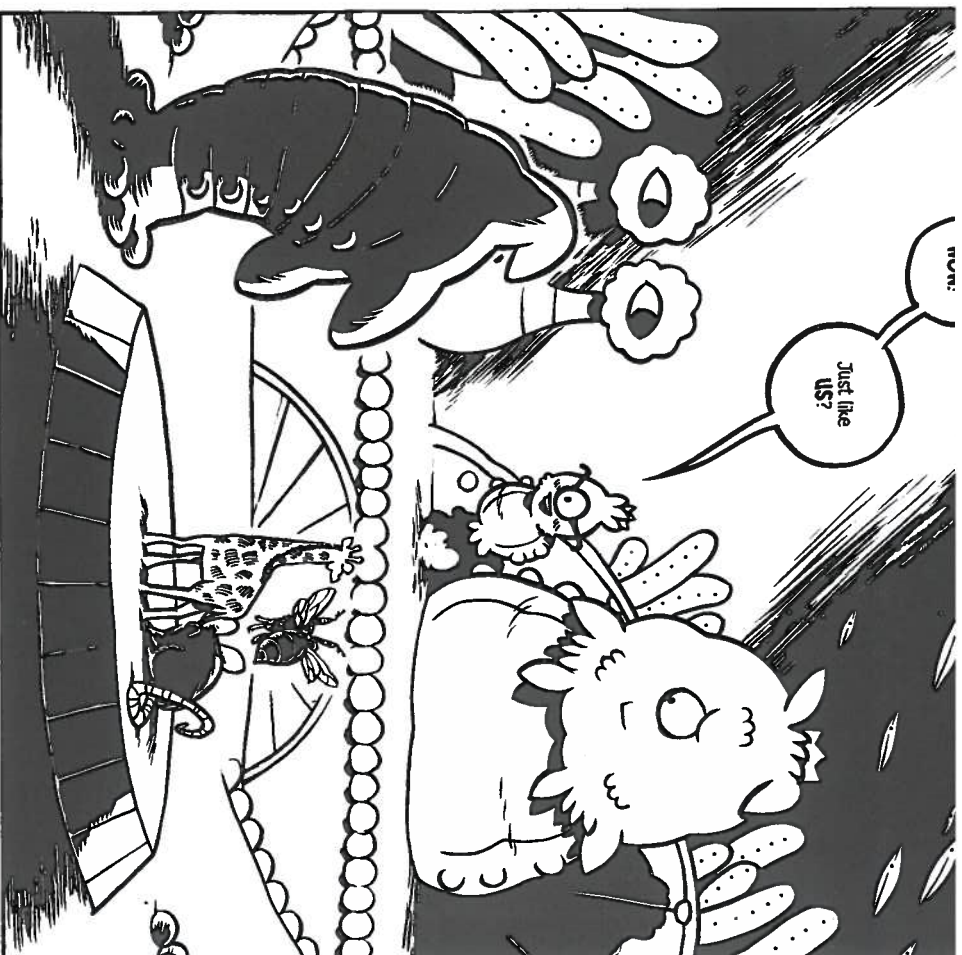
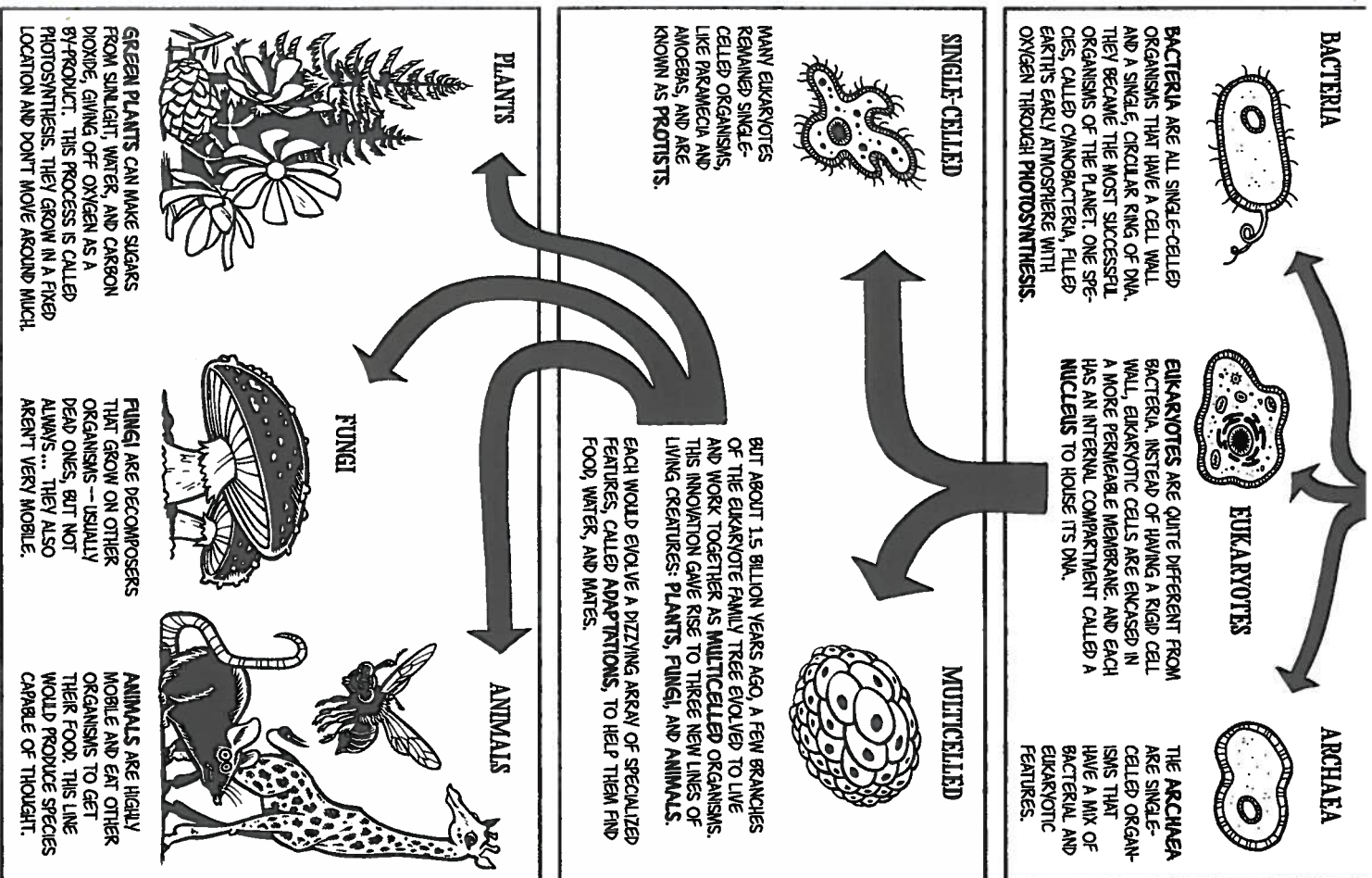


IN ADDITION TO PASSING THEIR GENETIC MATERIAL TO THEIR OFFSPRING, THESE EARLY CELLS ALSO FREELY SWAPPED GENETIC MATERIAL WITH OTHER, UNRELATED CELLS. THESE EXCHANGES ARE CALLED LATERAL TRANSFERS AND THEY PROMOTE VARIETY WITHIN POPULATIONS.

TRADE

DEAL.





STRAPE LIVING SPECIES LIKE
BIRDS THAT COULDN'T FLY AND
SNAKES WITH LEGS WERE
EVIDENCE THAT EVOLUTION
MIGHT BE AN ONGOING,
CONTINUOUS PROCESS.

THEY POKED THEIR WORLD, AND
POUNDERED THEIR WORLD, IN
TIME, THEY LEARNED TO READ
THE VERY ROCKS THEMSELVES.
FOSSILS OFFERED
THEM A GLIMPSE
AND CREA-
TURES THAT
HAD COME
AND GONE
LONG
BEFORE
THEIR TIME.

ABOUT THE HUMANS, THEN...
THEY MADE TOOLS THAT INCREASED
THEIR CHANCES OF SURVIVAL, AND
THEY MANIPULATED EVOLUTIONARY
PROCESSES TO TURN WILDLIFE INTO
DOMESTICATED LIVESTOCK AND
FOOD PLANTS.

I WILL BE HAPPY
TO REVIEW ANYTHING THE
PRINCE DESIRES, SIRE.
Well, I...uh...
started it.
Hmph. The Prince
should DESIRE to be more
thoroughly prepared if he ever
hopes to be king.

Wow! They sound fascinating.
Are we going to hear more
of this in his last report
on Earth. Didn't you
read it?
What do you mean?
Bloot covered much
of this in his last report
about these creatures?
Well, they sound fascinating.
Are we going to hear more
of this in his last report
on Earth. Didn't you
read it?

WITH THEIR GRASPING HANDS AND THEIR BIG
BRAINS, THE HUMANS CREATED LANGUAGE,
ART, AND SCIENCE. THEY DISCOVERED WAYS
TO DESCRIBE THE NATURAL WORLD AND THE
WORLD OF PURE ABSTRACTION.

QUITE RECENTLY, LESS THAN A QUARTER-MILLION
YEARS AGO, A TERRESTRIAL SPECIES EVOLVED
THAT WOULD DISTINGUISH ITSELF LIKE NO OTHER BY
RESHAPING THE WORLD WITH TWO STUBBY DIGITS
CALLED OPPOSABLE THUMBS.
NOW, THIS
IS WHAT I CALL AN
ADAPTATION.

THE EVOLUTION OF LIFE ON EARTH BEGAN IN
ITS SEAS, BUT ABOUT 450 MILLION YEARS AGO
A FULL-SCALE INVASION OF THE LAND BEGAN.
WITHIN 100 MILLION YEARS,
EARTH WAS COVERED IN
SPECIES THAT OOEZED,
SLITHERED, BLOOMED,
BURROWED, AND TOOK
TO THE AIR.

ANY INPUT YOU AND THE
PRINCE MIGHT HAVE WOULD
BE DEEPLY APPRECIATED,
TO WORK OUT ALL OF THE
BUGS BEFORE WE OPEN THE
MUSEUM TO THE PUBLIC.
Not all
these things are
cool.
Cool.

Well, certainly,
if it pleases you,
my son.
Can we
keep going, Dad?
Can we?

It's fine, I guess.
It isn't exactly
FUN PARK, but --
SQUINCHLAND
look at all of
these weird
creatures.
I think it's
great. Just
look at all of
these weird
creatures.

WHY, YES, YOUR
HIGHNESS.
THIS IS JUST THE INTRODUCTORY
HOLOGRAPHIC SEQUENCE TO
THE NEW...
GLARGALIAN
HOLOGRAPHIC INSTITUTE
OF EARTH EVOLUTION
(GHEE).
DOES IT MEET WITH
YOUR APPROVAL?



So, how did you figure it out, sir?

IT TOOK ME A LONG TIME. I SPENT THE FIRST HALF OF MY LIFE TRAINING FOR THIS DISCOVERY.



THE BOOK WAS A SENSATION AND SOLD OUT THE DAY IT WAS PUBLISHED.

PEOPLE WENT "ARE" FOR NATURAL SELECTION.

DADUM PTISSHH

uh...

I don't get it.



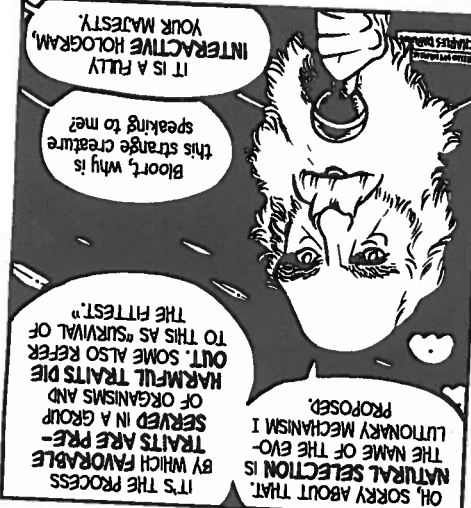
WHEN HUMANS LOOKED INWARD, THEY DISCOVERED HOW CLOSELY THEY WERE RELATED TO THEIR FELLOW PASSENGERS ON EARTH.

AS SCIENTISTS BEGAN COMPARING THE ANATOMY OF OTHER ANIMALS TO THEIR OWN, SOME OF THEM REALIZED THAT ALL LIFE ON EARTH WAS DEEPLY RELATED AND CONSTANTLY CHANGING. BUT THEY DIDN'T KNOW HOW.



AS A BOY, I COLLECTED EVERYTHING FROM ROCKS TO LITTLE BITS OF PLASTER.

O-o-o, THIS PEBBLE IS AWESOME.



OH, SORRY ABOUT THAT. NATURAL SELECTION IS THE NAME OF THE EVOLUTIONARY MECHANISM I PROPOSED.

IT'S THE PROCESS BY WHICH FAVORABLE TRAITS ARE PRESERVED IN A GROUP OF ORGANISMS AND HARMFUL TRAITS DIE OUT. SOME ALSO REFER TO THIS AS "SURVIVAL OF THE FITTEST."

Bloot, why is this strange creature speaking to me?

IT IS A FULLY INTERACTIVE HOLOGRAM, YOUR MAJESTY.



THEY HAVE, ABOUT 150 YEARS AGO A HUMAN NAMED CHARLES DARWIN PROPOSED A MECHANISM FOR EVOLUTION IN HIS BOOK "ON THE ORIGIN OF SPECIES."

Have they figured it out yet?



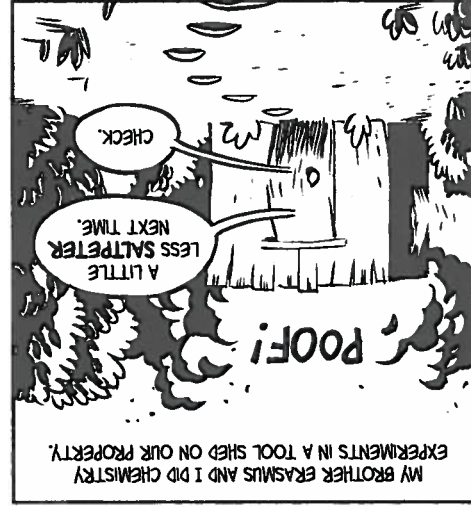
You became a MINISTER?

NOT QUITE.

JUST BEFORE I TOOK MY FINAL TESTS, I GOT THE OPPORTUNITY TO SAIL AROUND THE WORLD FOR FIVE YEARS.



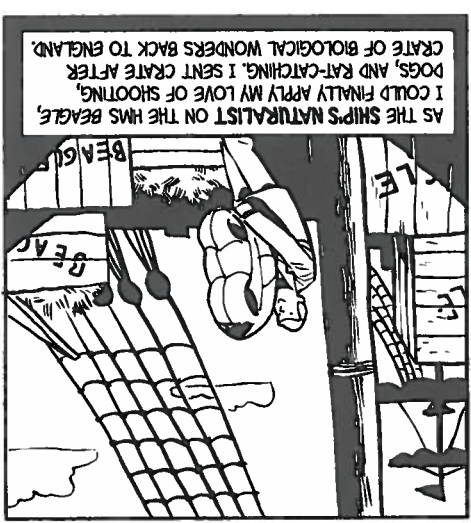
MY FATHER LET ME KNOW THAT HE WAS... CONCERNED... ABOUT MY LACK OF FOCUS. YOU CARE FOR NOTHING BUT SHOOTING, DOGS, AND RAT-CATCHING, AND YOU WILL BE A DISGRACE TO YOURSELF AND ALL YOUR FAMILY.



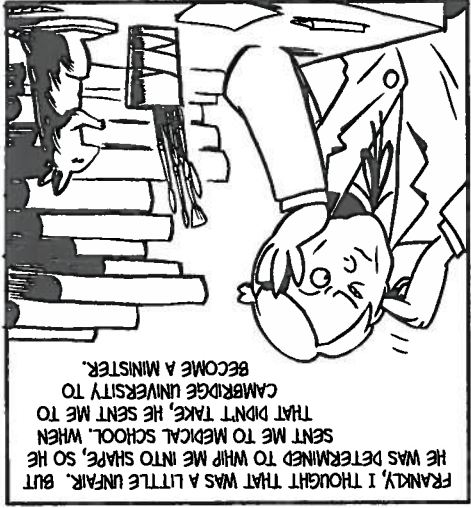
POOF!

A LITTLE LESS SALTPEETER NEXT TIME. CHECK.

MY BROTHER ERASMUS AND I DID CHEMISTRY EXPERIMENTS IN A TOOL SHED ON OUR PROPERTY.



AS THE SHIP'S NATURALIST ON THE HMS BEAGLE, I COULD FINALLY APPLY MY LOVE OF SHOOTING, DOGS, AND RAT-CATCHING. I SENT CRATE AFTER CRATE OF BIOLOGICAL WONDERS BACK TO ENGLAND.



FRANKLY, I THOUGHT THAT WAS A LITTLE UNFAIR. BUT HE WAS DETERMINED TO WHIP ME INTO SHAPE, SO HE SENT ME TO MEDICAL SCHOOL. WHEN THAT DIDN'T TAKE, HE SENT ME TO CAMBRIDGE UNIVERSITY TO BECOME A MINISTER.



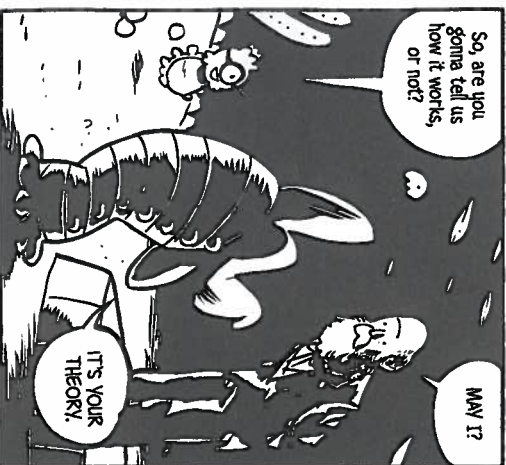
I DIDN'T CARE FOR SCHOOL MUCH BUT I WAS FASCINATED BY THE NATURAL WORLD. IN FACT, I WAS ONCE SO ENGROSSSED IN MY THOUGHTS THAT I WALKED RIGHT OFF A WALL.



HEN I GOT MARKED, MY KIDS, AND KAN EXPERIMENTS FOR THE NEXT TWENTY YEARS.



THE FAMOUS ENGLISH BIOLOGIST THOMAS HENRY HUXLEY SAID --
HOW STUPID OF ME NOT TO HAVE THOUGHT OF THAT!



So, are you gonna tell us how it works, or not?

MAY 12

IT'S YOUR THEORY.



BRILLIANT. SO, THERE ARE FOUR BASIC CONDITIONS THAT MUST BE MET FOR NATURAL SELECTION TO OCCUR.

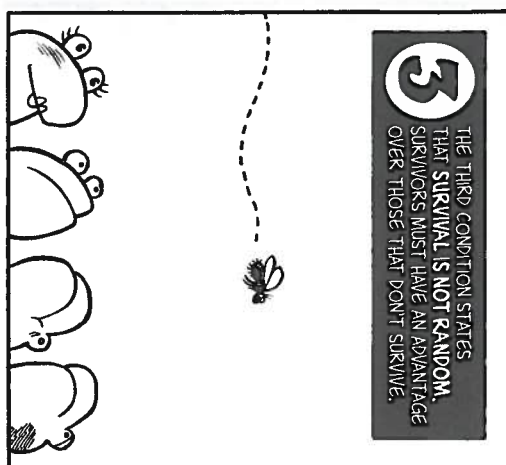


1 THE FIRST IS THAT TRAITS IN A POPULATION OF ORGANISMS EXHIBIT VARIATION.

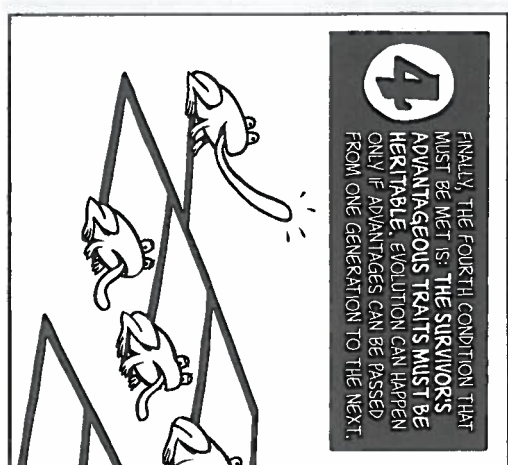
IN OTHER WORDS, EVERYBODY IS SLIGHTLY DIFFERENT. A QUICK LOOK AROUND WILL CONFIRM THAT MEMBERS OF ANY GIVEN SPECIES AREN'T EXACTLY ALIKE. INDIVIDUALS CAN VARY IN TRAITS THAT RANGE FROM SIZE AND SHAPE TO HOW THEY ACT OR HOW THEY FUNCTION CHEMICALLY.



NOT ALL INDIVIDUALS SUITING TO REPRODUCE.
THIS IS TRUE FOR EVERY ORGANISM. FROGS, FOR EXAMPLE, MAY PRODUCE THOUSANDS OF EGGS, BUT ONLY A HANDFUL LIVE LONG ENOUGH TO BECOME ADULT FROGS.



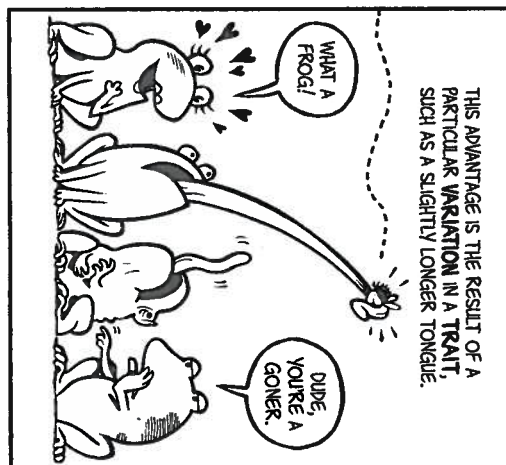
3 THE THIRD CONDITION STATES THAT SURVIVAL IS NOT RANDOM. SURVIVORS MUST HAVE AN ADVANTAGE OVER THOSE THAT DON'T SURVIVE.



4 FINALLY, THE FOURTH CONDITION THAT MUST BE MET IS: THE SURVIVORS' ADVANTAGEOUS TRAITS MUST BE HERITABLE. EVOLUTION CAN HAPPEN ONLY IF ADVANTAGES CAN BE PASSED FROM ONE GENERATION TO THE NEXT.

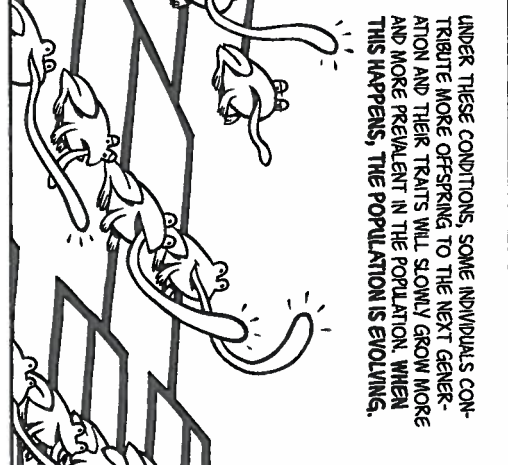


ON TOP OF SPAGHETTI!!!, ALL COVERED WITH CHEESEEEE...
IT HAD TO BE YOU... WONDERFUL YOUUUUU...

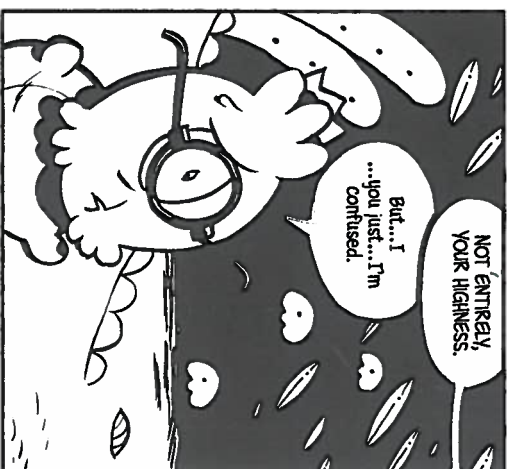
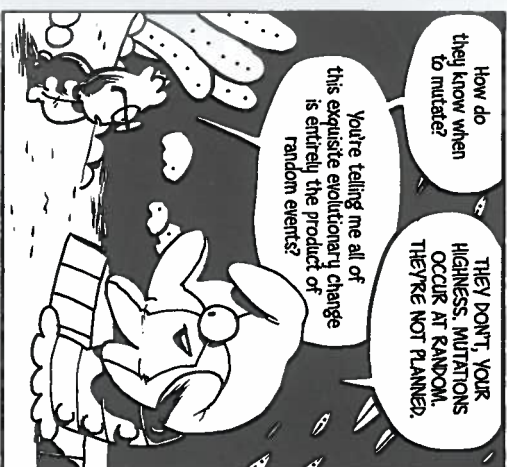
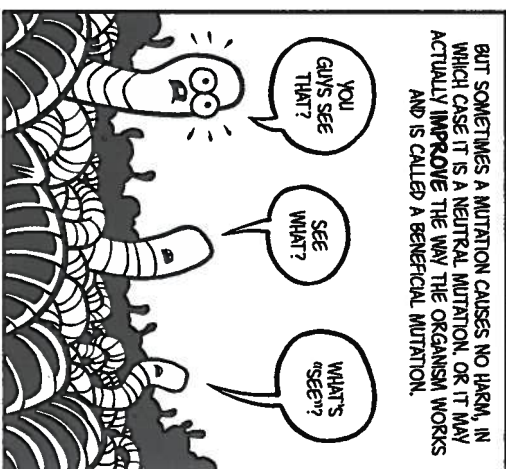
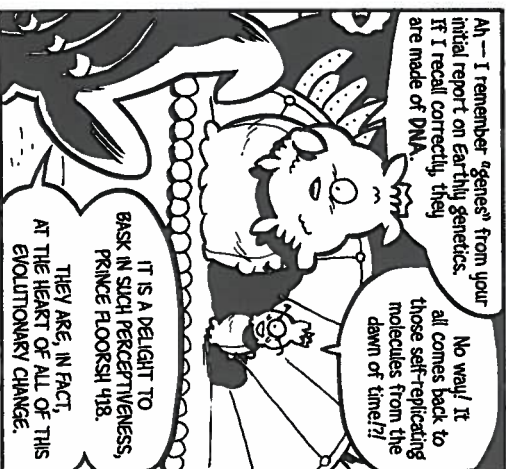
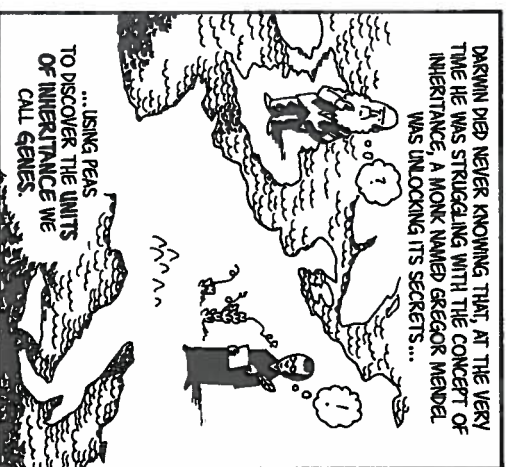


THIS ADVANTAGE IS THE RESULT OF A PARTICULAR VARIATION IN A TRAIT, SUCH AS A SLIGHTLY LONGER TONGUE.

WHAT A FROG!
DUDE, YOU'RE A GONER.



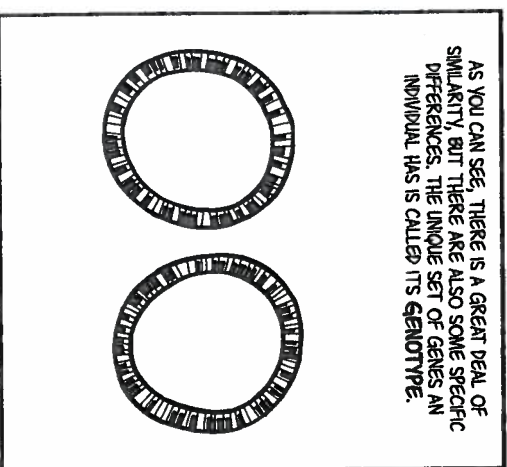
UNDER THESE CONDITIONS, SOME INDIVIDUALS CONTRIBUTE MORE OFFSPRING TO THE NEXT GENERATION AND THEIR TRAITS WILL SLOWLY GROW MORE AND MORE PREVALENT IN THE POPULATION. WHEN THIS HAPPENS, THE POPULATION IS EVOLVING.



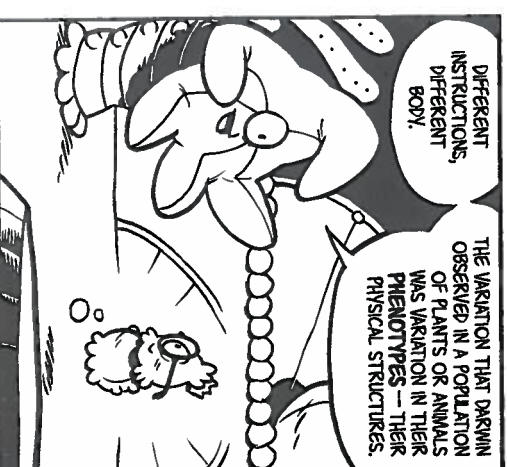


A CHROMOSOME IS A THREAD-LIKE STRUCTURE OF DNA THAT CONTAINS MULTIPLE GENES.

THE GENES ARE REPRESENTED BY DIFFERENT BUILDING PARTS OF THE BODY.

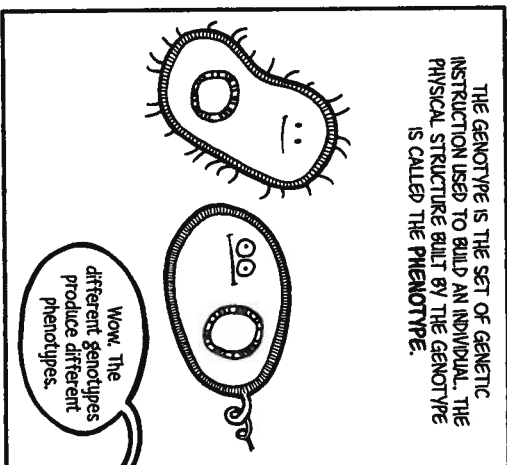


AS YOU CAN SEE, THERE IS A GREAT DEAL OF SIMILARITY, BUT THERE ARE ALSO SOME SPECIFIC DIFFERENCES. THE UNIQUE SET OF GENES AN INDIVIDUAL HAS IS CALLED ITS GENOTYPE.



THE VARIATION THAT DARWIN OBSERVED IN A POPULATION OF PLANTS OR ANIMALS WAS VARIATION IN THEIR PHENOTYPES — THEIR PHYSICAL STRUCTURES.

DIFFERENT INSTRUCTIONS, DIFFERENT BODY.



THE GENOTYPE IS THE SET OF GENETIC INSTRUCTIONS USED TO BUILD AN INDIVIDUAL. THE PHYSICAL STRUCTURE BUILT BY THE GENOTYPE IS CALLED THE PHENOTYPE.

Wow. The different genotypes produce different phenotypes.



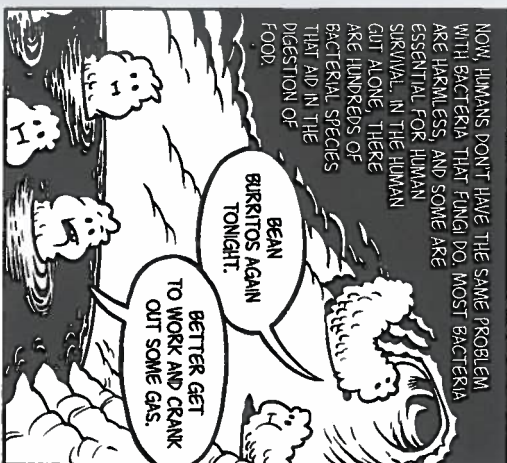
RANDOM MUTATIONS INTRODUCE NEW GENES THAT PRODUCE SLIGHTLY DIFFERENT PHENOTYPES. SO, MUTATIONS ARE RANDOM... BUT WHICH PHENOTYPES SURVIVE IS NOT.

THIS CAN BE SEEN QUITE CLEARLY IN A GROWING MEDICAL PROBLEM ON EARTH.



OF YEARS OF COMPETITION, THE FUNGUS HAS EVOLVED THE ADAPTIVE ABILITY TO SECRETE A CHEMICAL THAT KILLS THE COMPETING BACTERIA.

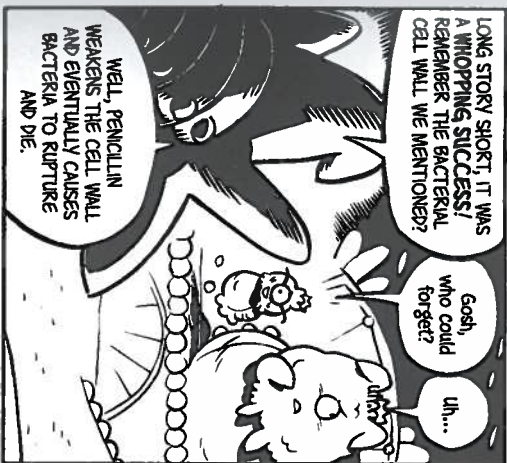
PENICILLIN MOLD



NOW, HUMANS DON'T HAVE THE SAME PROBLEM WITH BACTERIA THAT FINISH DO. MOST BACTERIA ARE HARMLESS, AND SOME ARE ESSENTIAL FOR HUMAN SURVIVAL. IN THE HUMAN GUT ALONE, THERE ARE HUNDREDS OF BACTERIAL SPECIES THAT AID IN THE DIGESTION OF FOOD.

BEAN BURRITOS AGAIN TONIGHT.

BETTER GET TO WORK AND CRANK OUT SOME GAS.



LONG STORY SHORT, IT WAS A WHOPPING SUCCESS! REMEMBER THE BACTERIAL CELL WALL WE MENTIONED?

Gosh, who could forget?

Uh...

WELL, PENICILLIN WEAKENS THE CELL WALL AND EVENTUALLY CAUSES BACTERIA TO RUPTURE AND DIE.

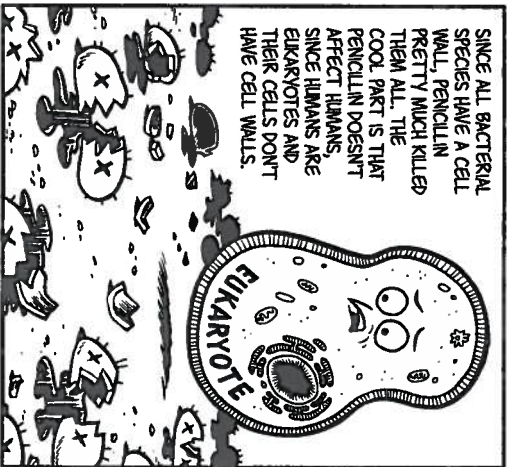


COLONIES HE WAS TRYING TO GROW.

I SHALL CALL IT... PENICILLIN.



BUT A HANDFUL OF BACTERIA CAUSE DISEASES THAT CAN INFECT AND KILL HUMANS. SO, NOT LONG AFTER PENICILLIN'S DISCOVERY, EARTH RESEARCHERS WERE TESTING ITS EFFECTIVENESS AS A MEDICAL TREATMENT.

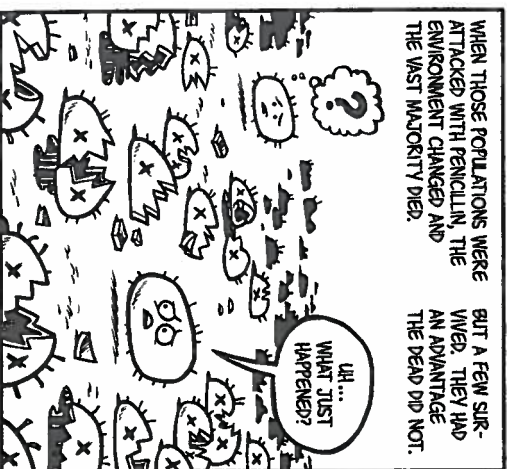
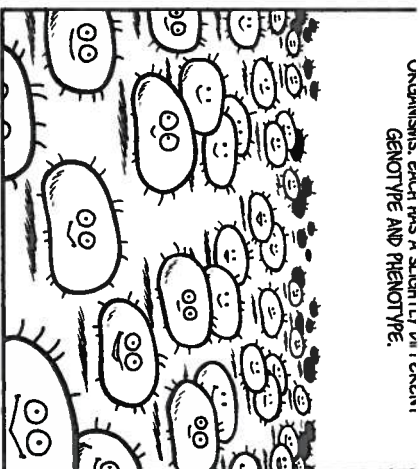


SINCE ALL BACTERIAL SPECIES HAVE A CELL WALL, PENICILLIN KILLED THEM ALL. THE COOL PART IS THAT PENICILLIN DOESN'T AFFECT HUMANS, SINCE HUMANS ARE EUKARYOTES AND THEIR CELLS DON'T HAVE CELL WALLS.

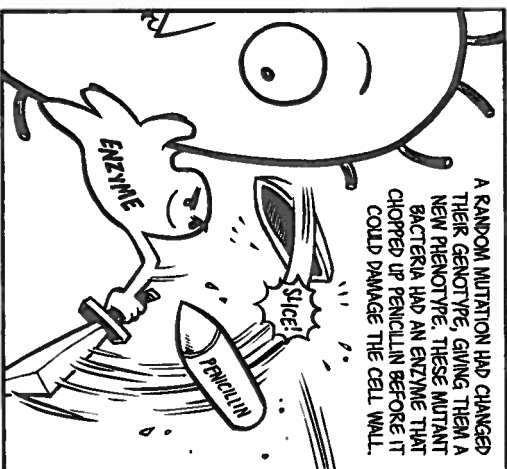
EUKARYOTE



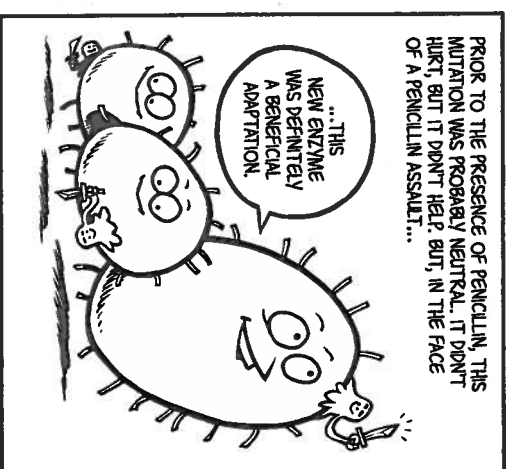
BUT OVER THE YEARS, THE "MAGIC" STARTED TO WEAR OFF. IT TOOK MORE AND MORE PENICILLIN TO KILL THE BACTERIA. THEY WERE EVOLVING.



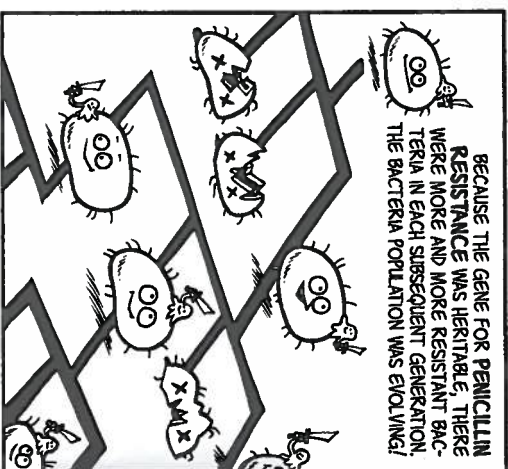
WHEN THOSE POPULATIONS WERE ATTACKED WITH PENICILLIN, THE ENVIRONMENT CHANGED AND THE DEAD DID NOT. BUT A FEW SURVIVED. THEY HAD AN ADVANTAGE. THE DEAD DID NOT.



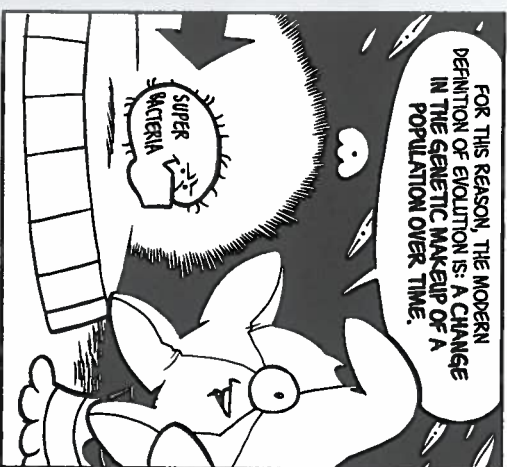
A RANDOM MUTATION HAD CHANGED THEIR GENOTYPE, GIVING THEM A NEW PHENOTYPE. THESE MUTANT BACTERIA HAD AN ENZYME THAT CHOPPED UP PENICILLIN BEFORE IT COULD DAMAGE THE CELL WALL.



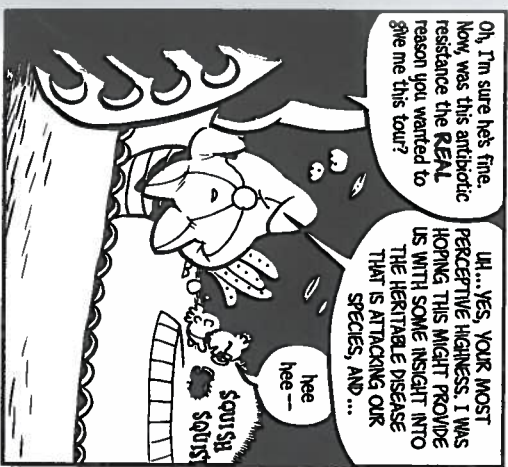
PRIOR TO THE PRESENCE OF PENICILLIN, THIS MUTATION WAS PROBABLY NEUTRAL. IT DIDN'T HURT, BUT IT DIDN'T HELP. BUT, IN THE FACE OF A PENICILLIN ASSAULT...



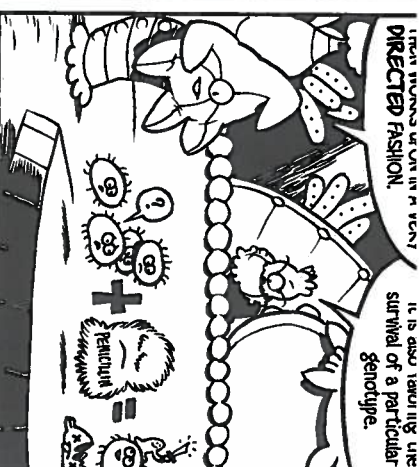
YEP BACTERIA DON'T MISS A TRICK.



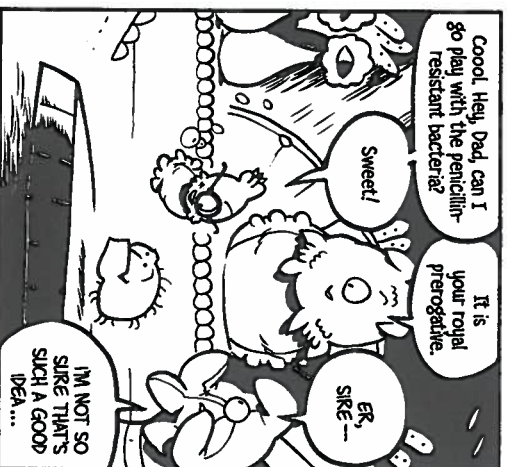
DEFINITION OF EVOLUTION IS: A CHANGE IN THE GENETIC MAKEUP OF A POPULATION OVER TIME.



UH... YES, YOUR MOST PERCEPTIVE HIGHNESS. I WAS HOPING THIS MIGHT PROVIDE US WITH SOME INSIGHT INTO THE HERITABLE DISEASE THAT IS ATTACKING OUR SPECIES, AND...



IT IS ALSO, VARIING THE SURVIVAL OF A PARTICULAR GENOTYPE.

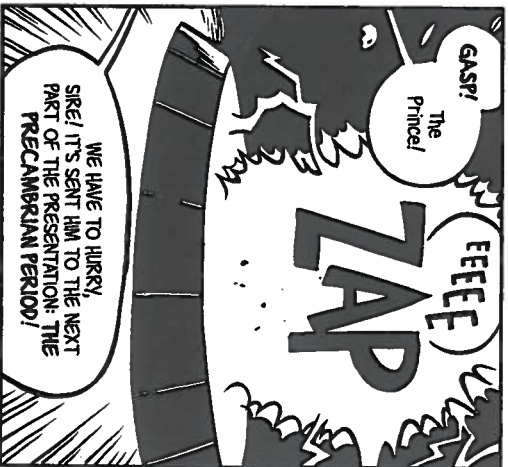


Cool. Hey, Dad, can I go play with the penicillin-resistant bacteriae?

Sweet!

ER, SURE...

I'M NOT SO SURE THAT'S SUCH A GOOD IDEA...



GASP! The Prince!

WE HAVE TO HURRY, SIRE! IT'S SENT HIM TO THE NEXT PART OF THE PRESENTATION: THE PRECAMBRIAN PERIOD!